

# Nosocomial outbreak of *Pseudomonas aeruginosa* folliculitis associated with a physiotherapy pool

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Outbreaks of community-acquired *Pseudomonas aeruginosa* folliculitis have recently been described in association with health spa whirlpools. In February 1984 we detected an outbreak of *Pseudomonas* folliculitis among hospital staff and patients using a swimming pool in a newly constructed physiotherapy unit. A rash developed in 5 (45%) of the 11 physiotherapists who had used the pool, as compared with 0 of the 17 who had not ( $p < 0.005$ ). *Pseudomonas* folliculitis also developed in 6 (21%) of 29 outpatients and 4 (33%) of 12 inpatients who had used the facility; *Pseudomonas* infection of a surgical wound also developed in 1 of the 4 inpatients. The epidemic curve was consistent with a continuing common-source outbreak. *P. aeruginosa*, serotype O:10, was isolated from three physiotherapists, the patient with an infected surgical wound and the pool. A case-control study of pool users did not identify risk factors for infection, although the physiotherapists had spent longer in the pool than had the patients. After hyperchlorination and structural repairs to the pool, no further cases were identified among pool users. This outbreak is the first reported nosocomial outbreak of *Pseudomonas* folliculitis. Further investigation is needed to determine the risk of serious *Pseudomonas* infections in hospitalized patients using physiotherapy pools.

Hors des hôpitaux, on a décrit récemment des épidémies de folliculite à *Pseudomonas aeruginosa* chez ceux qui fréquentent les bains-tourbillons thermaux. En février 1984 nous observons une telle

épidémie parmi le personnel hospitalier et les malades ayant utilisé la piscine d'un nouveau service de physiothérapie. Une éruption est survenue chez 5 (45%) de 11 physiothérapeutes l'ayant utilisée, contre 0 des 17 qui ne l'avaient pas fait ( $p < 0,005$ ). La folliculite à *Pseudomonas* se voit chez 6 (21%) de 29 malades externes et 4 (33%) de 12 malades internes ayant été en piscine; chez 1 des 4 malades internes, une plaie opératoire est infectée par ce microbe. L'allure de cette épidémie fait penser à une infection persistante de source unique. On isole un *P. aeruginosa* du sérotype O:10 à partir de trois physiothérapeutes, du porteur de la plaie infectée et de la piscine elle-même. L'enquête comparative entre les utilisateurs infectés et non infectés ne fait ressortir aucun facteur de risque, bien que le séjour en piscine des physiothérapeutes soit plus long que celui des malades. L'épidémie cède à la surchloration et à certaines réparations de la piscine. C'est la première du genre à être rapportée. Le risque d'infection grave à *Pseudomonas* chez les malades hospitalisés allant en piscine reste à préciser.

In 1975 McCausland and Cox<sup>1</sup> described an outbreak 3 years earlier of folliculitis due to a gram-negative organism in 42 of 60 people who had attended a bar mitzvah in St. Paul, Minnesota. *Pseudomonas aeruginosa* was isolated from the patients, and the source of infection was determined to be an improperly maintained motel whirlpool. Since that report, outbreaks of *Pseudomonas* folliculitis have frequently been described; the clinical and epidemiologic features of 17 outbreaks have recently been reviewed by Gustafson and colleagues.<sup>2</sup> In addition, a survey by Spitalny and associates<sup>3</sup> of state health departments in the United States documented 72 outbreaks of rash associated with the use of whirlpool spas. All previously reported outbreaks of *Pseudomonas* folliculitis have been community acquired, and a recent report of an outbreak due to *P. aeruginosa*

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serotype O:7 in St. John's, Nfld., suggests that *Pseudomonas* folliculitis represents a frequent public health problem in Canada as well.<sup>4</sup>

Despite the common use of Hubbard tanks and other hydrotherapy equipment in physiotherapy departments of both general and rehabilitative hospitals, no nosocomial outbreaks of folliculitis due to gram-negative organisms have been reported in association with such facilities. We recently identified and investigated such an outbreak of *P. aeruginosa* folliculitis involving staff, inpatients and outpatients using a newly constructed physiotherapy pool at a 900-bed general hospital.

## Materials and methods

### Index case

A painful rash on the trunk along with malaise, headache and nausea developed on Feb. 15, 1984, in a 27-year-old female physiotherapist working at Victoria General Hospital, Halifax, who was 21 weeks pregnant. Erythematous papules tender to palpation were scattered on her abdomen and trunk; several had a small central pustule (Fig. 1). Aerobic culture of *P. aeruginosa* from pustule material confirmed the tentative diagnosis of folliculitis due to a gram-negative organism. No therapy was offered, and the patient recovered uneventfully.

The physiotherapist did not usually participate in hydrotherapy classes for the rheumatology inpatients and outpatients who used a new swimming pool in a recently constructed physiotherapy facility. However, on four occasions (Feb. 8, 9, 13 and 14, 1984), while substituting for a colleague, she had accompanied groups of 6 to 10 patients exercising in the pool.

### Investigation

The index case was reported to the occupational health officer and the infection control officer (W.F.S.), Victoria General Hospital, and the Physiotherapy Department was notified and visited. It was learned that a rash had developed in a second physiotherapist after a single use of the pool in the previous week; *P. aeruginosa* was cultured from a healing lesion on her trunk.

On the basis of the two cases we began an investigation to detect further cases of rash-illness in staff and patients who had been treated in the Physiotherapy Department and to identify risk factors. Two case definitions were developed: (a) a raised, red rash that had appeared in the 6 weeks prior to interview in a physiotherapist; and (b) a raised, red rash that had appeared in a physiotherapist or a patient who had used the new swimming pool in the department.

A questionnaire was developed to collect basic demographic data on physiotherapy staff and pa-

tients, features of the rash and associated symptoms, potential predisposing conditions (such as immunosuppression, recent surgery, pregnancy or previous skin disorder) and potential environmental risk factors associated with hydrotherapy in the Physiotherapy Department, including immersion time, showering activities before and after exercise, towelling, time and duration of pool use, and use of floats. Physiotherapists and other staff within the department were asked to complete the questionnaire and were subsequently interviewed if they had been ill. All patients who were currently in hospital and had used the hydrotherapy facilities were interviewed and examined for evidence of rash or other infection. Discharged patients and outpatients who had used the facility were identified by examination of log books and contacted by telephone.

To identify possible risk factors for rash associated with treatment in the department, case-physiotherapists were compared with non-case-physiotherapists, and case-patients were compared with non-case-patients. In addition, to determine possible differences in use of the pool in the Physiotherapy Department, all recently hospitalized patients with *P. aeruginosa* infection (identified by review of the records for *P. aeruginosa* isolates in the Microbiology Department) were compared with patients who had had documented

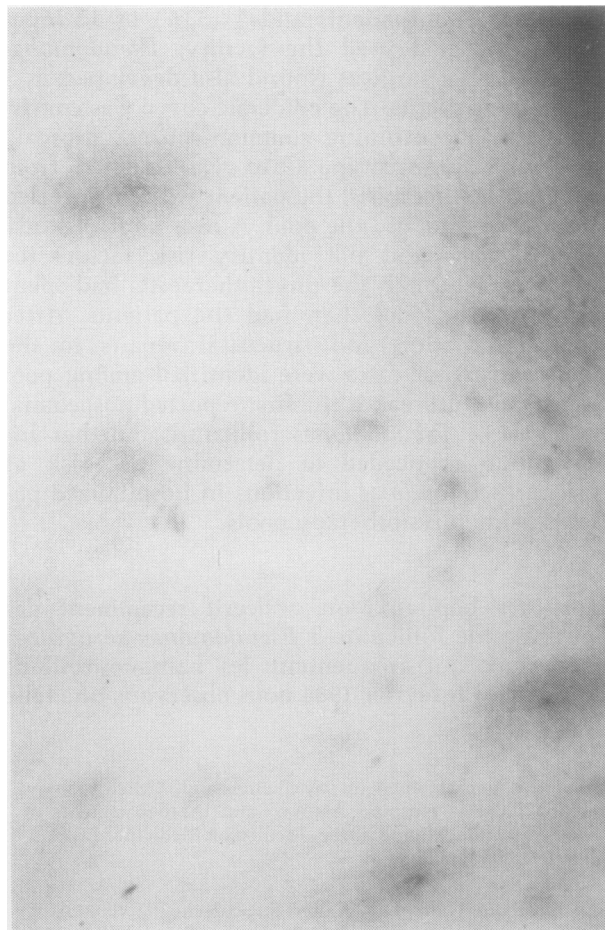


Fig. 1—*Pseudomonas* folliculitis in index case.

*Serratia marcescens* infections during the same period. *S. marcescens* was chosen because it is used as a marker for surveillance of gram-negative infections at our hospital.

Statistical analysis of the data was performed by Fisher's exact test or chi-square analysis.

After identification of the index case, and on the assumption that the Physiotherapy Department swimming pool was associated with the outbreak, the pool was closed for 24 hours and subsequently reopened. We visited the facility on Feb. 16, obtained 1-L aliquots of water in sterile containers from sites within the pool and examined the aliquots for bacterial growth according to standard methods.<sup>5</sup> Samples of water were also obtained for measurement of pH, temperature, concentration of chlorine residuals and the amount of organic debris.

## Results

Fifteen cases meeting our definitions were identified; the rash-illness had appeared between the last week of January and mid-February 1984 (Fig. 2). *P. aeruginosa* had been cultured from specimens from three physiotherapists and one inpatient; in the other 11 cases culture specimens had not been obtained. Symptoms other than rash were uncommon. Headache and malaise were reported by four (27%) of the patients. One patient complained of sore breasts, and one patient had a fever. No patient complained of earache or ear discharge. Gastrointestinal symptoms were limited to nausea in two patients and diarrhea in one patient.

A rash developed in 5 (45%) of the 11 physiotherapists who had used the pool in the Physiotherapy Department during the epidemic period, as compared with 0 of the 17 physiotherapists who had not used the pool but had used other hydrotherapy equipment in the department. The difference was statistically significant ( $p < 0.005$ , Fisher's exact test) and implicated the swimming pool as the source of infection. Among those who had used the pool during the epidemic period a rash developed in 5 (45%) of the 11 physiotherapists, as compared with 4 (33%) of 12 inpatients and 6 (21%) of 29 outpatients ( $p = 0.1$  by chi-square testing for a trend). Four patients who according to the appointment and log books had used the pool could not be located.

No other significant associations were found by univariate analysis when case-patients were compared with non-case-patients. However, the numbers in each group were small. On average the patients with a rash had spent longer in the pool than had those without a rash (mean times 189 and 148 minutes), but the times varied widely in both groups (from 60 to 600 minutes). Among inpatients, those with *Pseudomonas* infections had not spent longer in the pool on average than had those with *Serratia* infections.

Of particular interest was a 53-year-old minister being evaluated on the inpatient rheumatology service for myositis. He had undergone a diagnostic muscle biopsy of the leg but continued to participate in hydrotherapy classes from the day after the biopsy. Dermatitis developed, along with purulence in the surgical wound, and *P. aeruginosa* was cultured from the pus.

Examination of the swimming pool on the day

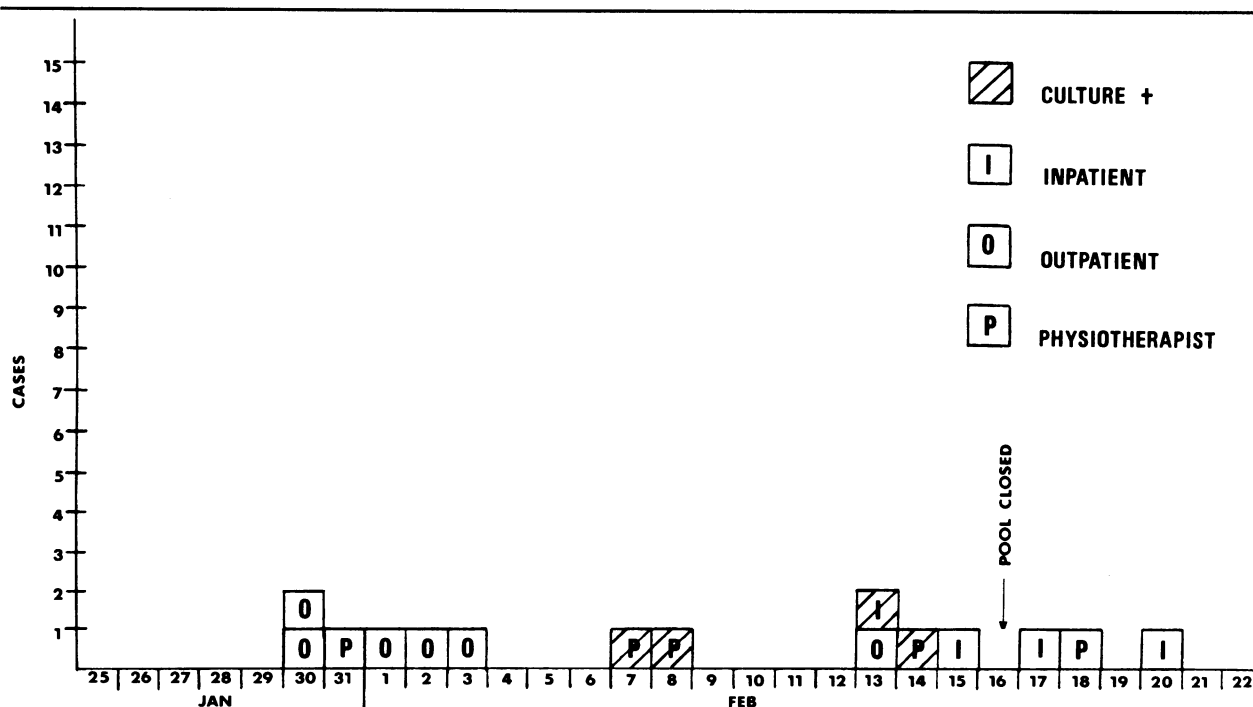


Fig. 2—Epidemic curve by date of onset of rash-illness.

after identification of the index case revealed a number of deficiencies in the pool's construction and use. The pool had been constructed as part of a new outpatient physiotherapy facility, which had opened 6 months prior to the outbreak. The automatic chlorinator had ceased to function shortly after the pool was put in use, and chlorination was performed haphazardly by manual means once or twice per day on average. No logs were kept of water conditions in the pool or of the schedule of chlorination. The filtering system was not operating properly, and organic debris was readily apparent in the pool. In addition, sealant materials had been improperly installed, so that there were areas in which organic debris had accumulated around peeling sealant.

At the time of investigation the pool's water had a temperature of 30°C, a pH of 7.4, a free chlorine concentration of 1 part per million (ppm), a chloride level of 8.17 mmol/L and an alkali level of 0.70 mmol/L. The growth pattern of *P. aeruginosa* in aliquots of the water (Table I) suggested heavy colonization in areas where slime was likely to be present — areas of debris and the skimmer.

Isolates of *P. aeruginosa* from three therapists with rash-illness, from the patient with infection of a surgical wound and from pool water were serotyped at the Bureau of Microbiology, Laboratory Centre for Disease Control, Ottawa; all the isolates were serotype O:10 according to the International Antigenic Typing Scheme.<sup>6</sup>

Hyperchlorination to a residual free chlorine concentration of 3 to 4 ppm was undertaken, with measurements performed twice daily — before the morning and afternoon use of the facility. Surveillance of rash-illness in patients and staff was maintained by the Physiotherapy and Infection Control departments. Structural changes, including acid wash, resealing of the pool, and repair of the automatic chlorinator and filter, were undertaken. No further cases of rash were identified, and since the reopening of the facility no growth of *P. aeruginosa* has been documented in routine surveillance cultures of the water.

## Discussion

Reported outbreaks of *P. aeruginosa* dermatitis have increased in frequency in parallel with the increasing popularity of commercially operated and home-based whirlpool spas.<sup>2,3</sup> Outbreaks of dermatitis associated with swimming pool use have been less frequent, possibly owing to more careful maintenance, with resultant adequate chlorination and a higher ratio of water volume to organic load. Also, in swimming pools, aerators are less commonly used and temperatures are usually kept lower, two factors that make rapid growth of *P. aeruginosa* less likely in the absence of an adequate chlorine concentration.

In contrast to the usual operation of swim-

ming facilities, the operation of our physiotherapy pool was more like that of a standard whirlpool spa. Temperatures were kept high for patient comfort, the ratio of water volume to organic load was small because of the size of the pool, therapy was in groups rather than individual, and 5 to 10 minutes of vigorous aeration of the water was a standard part of the therapeutic protocol. Excessive loads of organic debris related to faulty construction and maintenance probably contributed to the *Pseudomonas* overgrowth in the water. Of particular interest was the heavy growth of *Pseudomonas* from water with excessive amounts of debris in the presence of "adequate" free levels of chlorine (1 ppm).<sup>7</sup> This debris probably protected the organisms along the side of the pool and allowed a bloom of growth in open water when the chlorine concentration fell below inhibitory levels. Enhancement of protection from chlorine through exopolysaccharide production by *Pseudomonas* may also have played a role, as resistance of swimming pool isolates of *P. aeruginosa* to free chlorine by this mechanism has been suggested.<sup>8</sup>

Information obtained from previous outbreaks of *Pseudomonas* folliculitis suggests a short incubation period,<sup>2</sup> and the epidemic curve of our outbreak suggests that the pool provided a continuing common source of infection, probably attributable to intermittent blooms of *P. aeruginosa* in the water. Most outbreaks have been caused by *P. aeruginosa* serotype O:11; serotype O:10 is an infrequent isolate in this condition, having been responsible for a single reported outbreak of dermatitis<sup>2</sup> as well as an outbreak of acute otitis media associated with a whirlpool spa.<sup>9</sup> It is unclear why certain serotypes of *P. aeruginosa* are specifically associated with these superficial infections, although enzyme profiles may predict the virulence of these organisms.<sup>10</sup> Superhydration of the skin may predispose to invasion by these relatively nonpathogenic organisms.<sup>11</sup>

Our outbreak also demonstrates that *Pseudomonas* folliculitis should join the long list of hospital-acquired infections and should be considered in patients presenting with a rash who have received inpatient physiotherapy services involving immersion in water. In addition, such exposure should be sought for other *Pseudomonas* infections, a point emphasized by the development of a wound infection in one of our patients. Urinary

Table I—Colony counts of *Pseudomonas aeruginosa* in water obtained from the Physiotherapy Department swimming pool

Source of water	Colony count per millilitre of water
Surface before aeration	0
Subsurface before aeration	2
Surface after aeration	12
Skimmer	200
Debris/water mixture	> 10 <sup>5</sup>

tract infection,<sup>12</sup> otitis,<sup>9</sup> sepsis<sup>13</sup> and bacterial pneumonia<sup>14</sup> have been described in patients using whirlpool spas at home or at commercial facilities. We looked for evidence of hydrotherapy in other patients with *P. aeruginosa* infections in our hospital but were not able to document cases other than the single wound infection. However, the potential association of serious *P. aeruginosa* infections with such exposure should be considered by infection control practitioners evaluating patients with such infections. Serotype O:11 *P. aeruginosa*, most commonly implicated in outbreaks of *Pseudomonas* folliculitis, is also disproportionately represented in nosocomial outbreaks of more serious *Pseudomonas* infection.<sup>15,16</sup>

Another potential association also deserves consideration. Hydrotherapy is common in the rehabilitation of patients with serious spinal injuries and is a feature of the program at our provincial rehabilitation hospital. This group of patients, particularly those with bladder dysfunction requiring intermittent catheterization or the use of an indwelling catheter, has high rates of colonization or infection of the urinary tract with *P. aeruginosa*.<sup>16</sup> To our knowledge an association between hydrotherapy and urinary tract infection in this population has not been studied. There are no current recommendations from infection control authorities to limit exposure of catheterized patients to water potentially contaminated with *Pseudomonas*, and an informal survey of Canadian hospitals conducted by our department revealed that catheterized patients were not uniformly excluded from hydrotherapy. We suggest that further data on this issue be collected by infection control practitioners in order to define this potential problem and to develop more definitive guidelines for patient management.

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Dr. Schlech is a scholar of the Canadian Life and Health Insurance Association.

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## Defence against diseases

*Hear the rest, and you will marvel even more at the crafts and resources I've contrived. Greatest was this: in the former times if a man fell sick he had no defense against the sickness, neither healing food nor drink, nor unguent; but through the lack of drugs men wasted away, until I showed them the blending of mild simples wherewith they drive out all manner of diseases.*

—Aeschylus (525-456 BC)